

## Search Plan and Results

### Question

What is the impact of liquids vs. solid foods on energy intake and body weight? (DGAC 2010)

### Date Searched

12/10/09

### Inclusion Criteria

- January 2000 to December 2009
- Human subjects
- English language
- International
- *Sample size*: Minimum of 10 subjects per study arm; preference for larger sizes, if available
- *Dropout rate*: Less than 40%; preference for smaller dropout rates
- *Ages*: Children, two to 18 years; adults, 19 and older
- *Populations*: Healthy, those with elevated chronic disease risk.

### Exclusion Criteria

- Medical treatment or therapy
- Diseased subjects (already diagnosed with disease related to study purpose)
- Hospitalized patients
- Study population not from a developed country as defined by the Human Development Index (<http://hdr.undp.org/en/statistics/>)
- Animal studies
- In vitro studies
- Articles not peer reviewed (Websites, magazine articles, Federal reports, etc.).

### Search Terms: Search Vocabulary

((Liquid\* OR solid\*) AND ("Food and Beverages"[Mesh] OR (food[mh] AND beverages[mh]))) AND ("Total caloric consumption" OR "energy compensation" OR "dietary compensation" OR ("energy intake"[mh])))

("food form" OR "fluid calories" OR soup\* OR "energy drinks" OR "liquid calories" OR "solid foods") AND ("Total caloric consumption" OR "energy compensation" OR "dietary compensation" OR ("energy intake"[majr]))

("Food and Beverages"[Mesh] OR (food[mh] AND beverages[mh]) OR "food form" OR "fluid calories" OR soup\* OR "energy drinks" OR "liquid calories" OR "solid foods") AND ("body weight"[mh] OR adiposity[mh] OR "Body Mass Index"[mh] OR

"Overweight"[mh] OR "Obesity"[mh] OR "Weight Gain"[mh] OR "Waist-Hip Ratio"[Mesh])

Liquid\* AND solid\* AND ("Food and Beverages"[Mesh] OR (food[mh] AND beverages[mh])) AND ("body weight"[mh] OR adiposity[mh] OR "Body Mass Index"[mh] OR "Overweight"[mh] OR "Obesity"[mh] OR "Weight Gain"[mh] OR "Waist-Hip Ratio"[Mesh])

## Electronic Databases

PubMed.

**Total hits from all electronic database searches:** 339

**Total articles identified to review from electronic databases:** 34

Articles Identified Via Handsearch or Other Means

### **Hand Search (Two articles)**

Almiron-Roig E, Flores SY, Drewnowski A. [No difference in satiety or in subsequent energy intakes between a beverage and a solid food.](#) *Physiol Behav.* 2004 Sep 30; 82(4): 671-677. PMID: 15327915.

Moorhead SA, Welch RW, Barbara M, Livingstone E, McCourt M, Burns AA, Dunne A. [The effects of the fibre content and physical structure of carrots on satiety and subsequent intakes when eaten as part of a mixed meal.](#) *Br J Nutr.* 2006; 96(3): 587-595. PMID: 16925866.

---

Summary of Articles Identified to Review

**Number of Primary Articles Identified:** 12

**Number of Review Articles Identified:** 0

**Total Number of Articles Identified:** 12

**Number of Articles Reviewed but Excluded:** 24

---

List of Articles Included for Evidence Analysis

Almiron-Roig E, Flores SY, Drewnowski A. [No difference in satiety or in subsequent energy intakes between a beverage and a solid food](#). *Physiol Behav*. 2004 Sep 30; 82(4): 671-677. PMID: 15327915. (Hand search)

Bertrais S, Galan P, Renault N, Zarebska M, Preziosi P, Hercberg S. [Consumption of soup and nutritional intake in French adults: Consequences for nutritional status](#). *J Hum Nutr Diet*. 2001 Apr; 14(2): 121-128. PMID: 11330261.

Chen L, Appel LJ, Loria C, Lin PH, Champagne CM, Elmer PJ, Ard JD, Mitchell D, Batch BC, Svetkey LP, Caballero B. [Reduction in consumption of sugar-sweetened beverages is associated with weight loss: the PREMIER trial](#). *Am J Clin Nutr*. 2009 May; 89(5): 1, 299-1, 306. Epub 2009 Apr 1. PMID: 19339405; PMCID: PMC2676995.

DiMeglio DP, Mattes RD. [Liquid vs. solid carbohydrate: Effects on food intake and body weight](#). *Int J Obes Relat Metab Disord*. 2000 Jun; 24(6): 794-800. PMID: 10878689.

Flood JE, Rolls BJ. [Soup preloads in a variety of forms reduce meal energy intake](#). *Appetite*. 2007 Nov; 49(3): 626-634. Epub 2007 Apr 14. PMID: 17574705; PMCID: PMC2128765.

Flood-Obbagy JE, Rolls BJ. [The effect of fruit in different forms on energy intake and satiety at a meal](#). *Appetite*. 2009 Apr; 52(2): 416-422. Epub 2008 Dec 6. PMID: 19110020; PMCID: PMC2664987.

Mattes RD, Campbell WW. [Effects of food form and timing of ingestion on appetite and energy intake in lean young adults and in young adults with obesity](#). *J Am Diet Assoc*. 2009 Mar; 109(3): 430-437. PMID: 19248858; PMCID: PMC2680008.

Moorhead SA, Welch RW, Barbara M, Livingstone E, McCourt M, Burns AA, Dunne A. [The effects of the fibre content and physical structure of carrots on satiety and subsequent intakes when eaten as part of a mixed meal](#). *Br J Nutr*. 2006; 96(3): 587-595. PMID: 16925866. (Hand search)

Mourao DM, Bressan J, Campbell WW, Mattes RD. [Effects of food form on appetite and energy intake in lean and obese young adults](#). *Int J Obes (Lond)*. 2007 Nov; 31(11): 1, 688-1, 695. Epub 2007 Jun 19. PMID: 17579632.

Rolls BJ, Roe LS, Beach AM, Kris-Etherton PM. [Provision of foods differing in energy density affects long-term weight loss](#). *Obes Res*. 2005 Jun; 13(6): 1, 052-1, 060. PMID: 15976148.

Stull AJ, Apolzan JW, Thalacker-Mercer AE, Iglay HB, Campbell WW. [Liquid and solid meal replacement products differentially affect postprandial appetite and food intake in older adults](#). *J Am Diet Assoc*. 2008 Jul; 108(7): 1, 226-1, 230. PMID: 18589034; PMCID: PMC2556245.

Tsuchiya A, Almiron-Roig E, Lluch A, Guyonnet D, Drewnowski A. [Higher satiety ratings following yogurt consumption relative to fruit drink or dairy fruit drink](#). *J Am Diet Assoc*. 2006 Apr; 106(4): 550-557. PMID: 16567151.

---

## List of Excluded Articles with Reason

---

Articles	Reason for Exclusion
Almiron-Roig E, Chen Y, Drewnowski A. <a href="#">Liquid calories and the failure of satiety: How good is the evidence?</a> <i>Obes Rev.</i> 2003 Nov; 4(4): 201-212. Review. PMID: 14649371.	Study design is narrative review.
Bachman CM, Baranowski T, Nicklas TA. <a href="#">Is there an association between sweetened beverages and adiposity?</a> <i>Nutr Rev.</i> 2006 Apr; 64(4): 153-174. Review. PMID: 16673752.	Study design is narrative review.
Ballistreri MC, Corradi-Webster CM. <a href="#">Consumption of energy drinks among physical education students.</a> <i>Rev Lat Am Enfermagem.</i> 2008 Jul-Aug; 16 Spec No: 558-564. PMID: 18709275.	Does not answer question; does not examine liquids vs. solids.
Bell EA, Roe LS, Rolls BJ. <a href="#">Sensory-specific satiety is affected more by volume than by energy content of a liquid food.</a> <i>Physiol Behav.</i> 2003 Apr; 78(4-5): 593-600. PMID: 12782213.	Does not answer question; does not examine liquids vs. solids; does not include energy intake or body weight in analyses.
Briefel RR, Wilson A, Gleason PM. <a href="#">Consumption of low-nutrient, energy-dense foods and beverages at school, home, and other locations among school lunch participants and nonparticipants.</a> <i>J Am Diet Assoc.</i> 2009 Feb; 109(2 Suppl): S79-S90. PMID: 19166676.	Does not answer question; does not examine liquids vs. solids.
Burger KS, Kern M, Coleman KJ. <a href="#">Characteristics of self-selected portion size in young adults.</a> <i>J Am Diet Assoc.</i> 2007 Apr; 107(4): 611-618. PMID: 17383267.	Does not answer question; does not examine liquids vs. solids.
Dennis EA, Flack KD, Davy BM. <a href="#">Beverage consumption and adult weight management: A review.</a> <i>Eat Behav.</i> 2009 Dec; 10(4): 237-246. Epub 2009 Jul 16. Review. PMID: 19778754.	Does not answer question; does not examine liquids vs. solids.
Drewnowski A, Bellisle F. <a href="#">Liquid calories, sugar, and body weight.</a> <i>Am J Clin Nutr.</i> 2007 Mar; 85(3): 651-661. Review. Erratum in: <i>Am J Clin Nutr.</i> 2007 Jun; 85(6): 1, 668. PMID: 17344485.	Study design is narrative review.
Ello-Martin JA, Ledikwe JH, Rolls BJ. <a href="#">The influence of food portion size and energy density on energy intake: implications for weight management.</a> <i>Am J Clin Nutr.</i> 2005 Jul; 82(1 Suppl): 236S-241S. Review. PMID: 16002828.	Does not answer question; does not examine liquids vs. solids.
Frecka JM, Hollis JH, Mattes RD. <a href="#">Effects of appetite, BMI, food form and flavor on mastication: almonds as a test food.</a> <i>Eur J Clin Nutr.</i> 2008 Oct; 62(10): 1, 231-1, 238. Epub 2007 Jul 18. PMID: 17637602.	Does not answer question; does not examine liquids vs. solids.

<p>Harrington S. <a href="#">The role of sugar-sweetened beverage consumption in adolescent obesity: A review of the literature</a>. <i>J Sch Nurs.</i> 2008 Feb; 24(1): 3-12. Review. PMID: 18220450.</p>	<p>Does not answer question; does not examine liquids vs. solids.</p>
<p>Johnson L, Mander AP, Jones LR, Emmett PM, Jebb SA. <a href="#">Is sugar-sweetened beverage consumption associated with increased fatness in children?</a> <i>Nutrition.</i> 2007 Jul-Aug; 23(7-8): 557-563. PMID: 17616342.</p>	<p>Does not answer question; does not examine liquids vs. solids.</p>
<p>Lecheminant JD, Gibson CA, Sullivan DK, Hall S, Washburn R, Vernon MC, Curry C, Stewart E, Westman EC, Donnelly JE. <a href="#">Comparison of a low carbohydrate and low fat diet for weight maintenance in overweight or obese adults enrolled in a clinical weight management program</a>. <i>Nutr J.</i> 2007 Nov 1; 6: 36. PMID: 17976244; PMCID: PMC2228297.</p>	<p>Does not answer question; does not examine liquids vs. solids.</p>
<p>Mattes R. <a href="#">Fluid calories and energy balance: the good, the bad, and the uncertain</a>. <i>Physiol Behav.</i> 2006 Aug 30; 89(1): 66-70. Epub 2006 Mar 6. Review. PMID: 16516935.</p>	<p>Study design is narrative review.</p>
<p>Mattes RD. <a href="#">Food palatability, rheology, and meal patterning</a>. <i>JPEN J Parenter Enteral Nutr.</i> 2008 Sep-Oct; 32(5): 572-574. PMID: 18753396.</p>	<p>Does not answer question; does not examine liquids vs. solids.</p>
<p>Mattes RD, Rothacker D. <a href="#">Beverage viscosity is inversely related to postprandial hunger in humans</a>. <i>Physiol Behav.</i> 2001 Nov-Dec; 74(4-5): 551-557. PMID: 11790415.</p>	<p>Does not answer question; does not examine liquids vs. solids; examines beverage viscosity.</p>
<p>Norton GN, Anderson AS, Hetherington MM. <a href="#">Volume and variety: relative effects on food intake</a>. <i>Physiol Behav.</i> 2006 Apr 15; 87(4): 714-722. Epub 2006 Mar 3. PMID: 16516251.</p>	<p>Does not answer question; does not examine liquids vs. solids.</p>
<p>O'Connor TM, Yang SJ, Nicklas TA. <a href="#">Beverage intake among preschool children and its effect on weight status</a>. <i>Pediatrics.</i> 2006 Oct; 118(4): e1, 010-e1, 018. PMID: 17015497.</p>	<p>Does not answer question; does not examine liquids vs. solids.</p>
<p>Rolls BJ, Drewnowski A, Ledikwe JH. <a href="#">Changing the energy density of the diet as a strategy for weight management</a>. <i>J Am Diet Assoc.</i> 2005 May; 105(5 Suppl 1): S98-S103. Review. PMID: 15867904.</p>	<p>Study design is narrative review.</p>
<p>Rothacker DQ, Watemberg S. <a href="#">Short-term hunger intensity changes following ingestion of a meal replacement bar for weight control</a>. <i>Int J Food Sci Nutr.</i> 2004 May; 55(3): 223-226. PMID: 15223599.</p>	<p>Does not answer question; does not examine liquids vs. solids; examines meal replacement bar.</p>

<p>Rush E, Schulz S, Obolonkin V, Simmons D, Plank L. <a href="#">Are energy drinks contributing to the obesity epidemic?</a> <i>Asia Pac J Clin Nutr.</i> 2006; 15(2): 242-244. PMID: 16672210.</p>	<p>Does not answer question; does not examine liquids vs. solids.</p>
<p>Tieken SM, Leidy HJ, Stull AJ, Mattes RD, Schuster RA, Campbell WW. <a href="#">Effects of solid versus liquid meal-replacement products of similar energy content on hunger, satiety, and appetite-regulating hormones in older adults.</a> <i>Horm Metab Res.</i> 2007 May; 39(5): 389-394. PMID: 17533583; PMCID: PMC2197163.</p>	<p>Sample size less than inclusion criteria.</p>
<p>West DS, Bursac Z, Quimby D, Prewitt TE, Spatz T, Nash C, Mays G, Eddings K. <a href="#">Self-reported sugar-sweetened beverage intake among college students.</a> <i>Obesity (Silver Spring).</i> 2006 Oct; 14(10): 1, 825-1, 831. PMID: 17062813.</p>	<p>Does not answer question; does not examine liquids vs. solids.</p>
<p>Zijlstra N, Mars M, de Wijk RA, Westerterp-Plantenga MS, de Graaf C. <a href="#">The effect of viscosity on ad libitum food intake.</a> <i>Int J Obes (Lond).</i> 2008 Apr; 32(4): 676-683. Epub 2007 Dec 11. PMID: 18071342.</p>	<p>Does not include energy intake or body weight in analyses.</p>